 ISSN : 2442-8876

TRIALLING PISA PROBLEMS IN SECONDARY SCHOOL

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Abstrak

This article is a report of trialing PISA problems designed in secondary school. This report explores students' strategies in solving PISA problems which has three criterion, namely content, context and competencies. Hopefully, first, they should be usual with the PISA problems related to description of the situation and the students have to discover and solve the problems with their own strategies. Second, they can solve the problem without require applying formulas or procedures, so that they have sense to mathematics.

Keyword: PISA Problem

INTRODUCTION

The main problem in Indonesian education especially in secondary school is students' low achievement and confidence in mathematics. For instance, students' lower score achievement of examinations in mathematics. At the international level, Indonesian students' performance achievement is still under average value. Based on the result of the Third International Mathematics and Science Study (TIMSS), the achievement of Indonesian pupils in mathematics was ranked 39th out of 41 participating countries (PISA, 2003).

There are 3 main problems causing the problem above. One of them is assessment approach other than mathematics curriculum materials and teaching method (Zulkardi, 2002). The teachers less involve the context in instructional process, formative evaluation in particularly. This situation makes the pupils no feeling of sense of mathematical concepts in solving problems by expectation they can develop and emerge their own new strategies. In other word, Mathematics problems used in assessment activities focus merely on algorithms and procedures and they lack elements of practical application (Suryanto, 1996; in Zulkardi, 2002).

Furthermore, in school, mathematics education is only considered as condition to enter the next study. But actually, mathematics is also a condition to form the students as critical and smart community or we call mathematical literacy.

The aim of this article is to report trialing PISA problem in Secondary school . This school has several bilingual classes as international school program. The students rather frequently discuss test in every Saturday as one of extracurricular activities. They are usual with the mechanistic problem using the procedure and formula to solve every problem. However, when the PISA problems related with everyday life (contextual) were tested, they were not familiar with the problems which demand students' own strategies to solve them. Firstly, they feel peculiar with the form of PISA problems, but they were becoming more comfort with the challenge of the problems. It is proved by pupils' responses in reflection session.

PISA FRAMEWORK

The Program for International Student Assessment (PISA) created in 1997 is the Organization for Economic Cooperation and Development (OECD) and government. The main goal of PISA is support data on the competencies of 15 year olds. OECD program monitors the outcomes of education system in terms of students' achievements. PISA focuses on literacy - the ability to use and apply knowledge and skills to real world situations encountered in adult life. The curriculum contains *contents* and *competency clusters*. The contents of the Mathematics test contain change and relationship, quantity, space and shape, uncertainty.

As regarding competency clusters, those evaluated by PISA are reproduction, connections, and reflection.In addition, context for the mathematical task for students were identified in three levels (de Lange 2007):

1. Reproduction: simple or routine computations, definitions, and (one-step or familiar) problems that need almost no mathematization.
2. Connection: somewhat more complex problem solving that involves making connections (between different mathematical domains, between the mathematics and the context).
3. Reflection/analysis: mathematical thinking, generalization, abstraction and reflection, and complex mathematical problem solving.

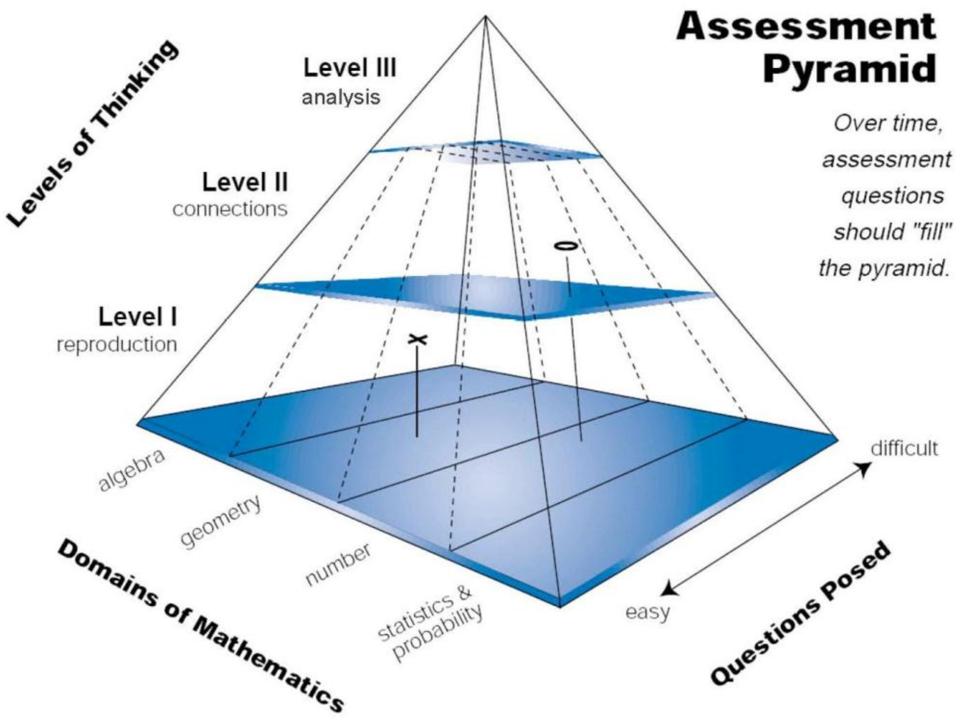


Figure1:*Assessment Pyramid. Adapted from [Shafer & Foster, 1997]*

PISA mathematics framework has characteristics, namely ML + 3Cs. Mathematical literacy (ML) is "the capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned and reflective citizen" (PISA, 2003).

It is concerned with the capacities of students to analyze, reason, and communicate their idea in mathematical posing, formulating, solving and interpreting in various situations. 3Cs are content, context and competencies. These components are illustrated below:

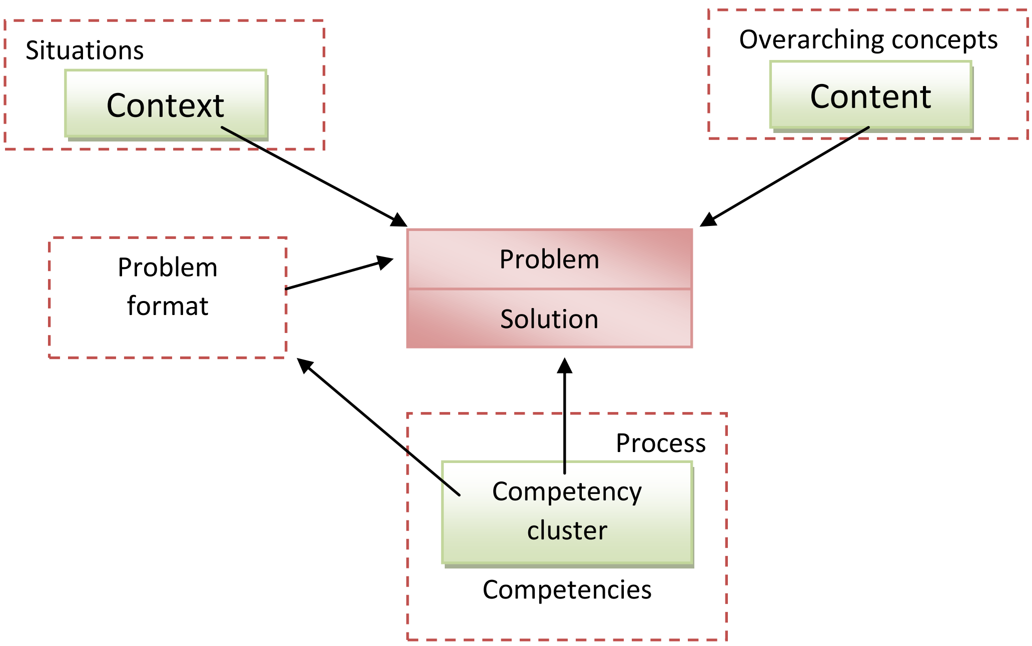


Figure2: *Components of the PISA mathematics domain. Adapted from [PISA 2009, P. 18]*

In mathematics education, students should be able to conceive the sense and the usefulness of mathematics itself in their everyday life. Mathematics Contextual problem is the problem that uses various contexts, so that it can present the real situation for the children (Zulkardi, 2002). Context means situation or phenomenon related to the mathematics concept.

There are four context or situational problem (de Lange, 1987; in zukardi, 2006)

1. Personal, the situation related to students' everyday life such as family, friends.
2. Educational and occupational, the contexts include problem situations that students might confront while at school, including those rather artificial problems designed specifically for teaching or practice purpose, or problems that would be met in situation.
3. Public, the situation related to society activities or the situations experienced in one's day to day interacts with the outside world.

4. Scientific, the situation related to phenomenon and scientific substance.

TEST DESIGN CHARACTERISTICS

Below the characteristic test design of PISA (PISA, 2003):

1. A full test should be 'balanced', which means that the competencies *reproduction*, *connections*, and *reflection* are addressed. (See Dutch pyramid model included)
2. A context used as problem situation should be as authentic as possible. Note that 'authentic' may involve fictitious elements such as the name of a country, the currency used, etcetera.
3. If a problem situation is used to ask mathematical questions, the starting point is the situation and not the mathematical content.
4. The questions asked within a context should be meaningful; the designer should ask herself "Why would anybody want to know?"
5. A 'rich' context enables mathematical questions from different domains. In general, limit yourself to one mathematical domain, e.g. algebra and use the context again for a different mathematical domain.
6. For less able students, the context should be closer to the student. For these students a scientific context is less suitable.
7. The language used must be adapted for the age and competencies of the students taking the test. This means for example that the text of a newspaper article used as a starting point for a (mathematical) question being posed almost always needs to be changed.
8. The first question to be posed within a context situation (if more than one question is posed) should enable students to get 'involved' in the context. Usually this will be a simple question at the reproduction level.
9. The number of questions to be used with one context is advised to be 3 – 5 to keep students motivated.
10. Make it clear whether or not the question posed should be solved within the situation or within the *mathematical model* of the situation. (For test purposes often a mathematical model of the situation is already provided).

TRIALING PISA PROBLEM

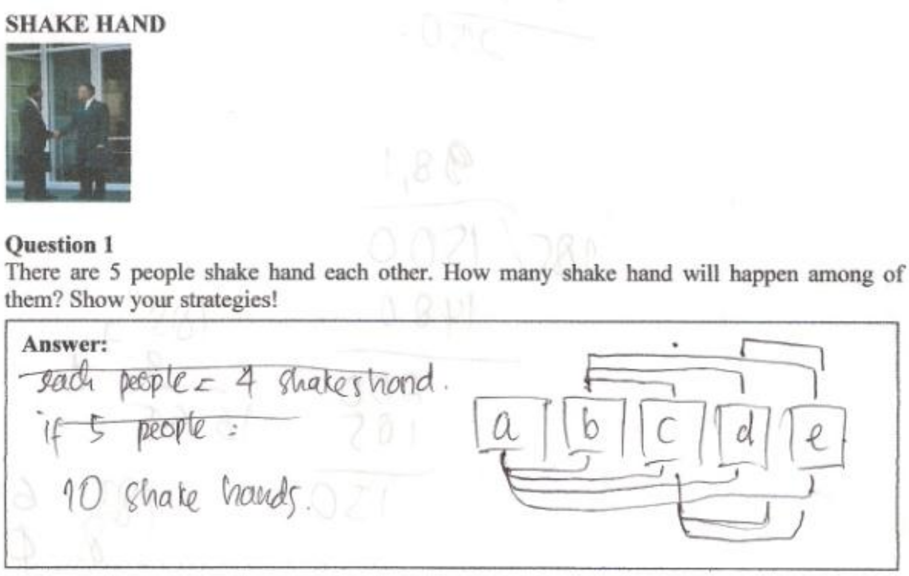
The tested explores the implementation of PISA problems in junior high school by involving 30 pupils. The first, the pupils feel unusual with the problems demanding their own strategies to solve them. They exercised the mechanistic problem usually whereby they commonly use the procedure and formula to solve the problems. It makes them lumpish. The question and exemplars of pupils work are shown in appendix 1. We shall now look at some examples of the PISA problem and students' solutions offered, and their activities.

Students' activities in PISA test

Firstly, researchers communicated to the students about the goal of the activities as introduction. Researchers explained the model of problems and asked the students to solve them with their own strategies. They did the test enthusiastically because the problems, it was the first for them, were different from what they had done usually. Following the condition of trialing PISA problems

Figure3. The condition of trialling PISA problems

Some examples of the PISA problem and students' solutions



SHAKE HAND

Question 1

There are 5 people shake hand each other. How many shake hand will happen among of them? Show your strategies!

Answer:

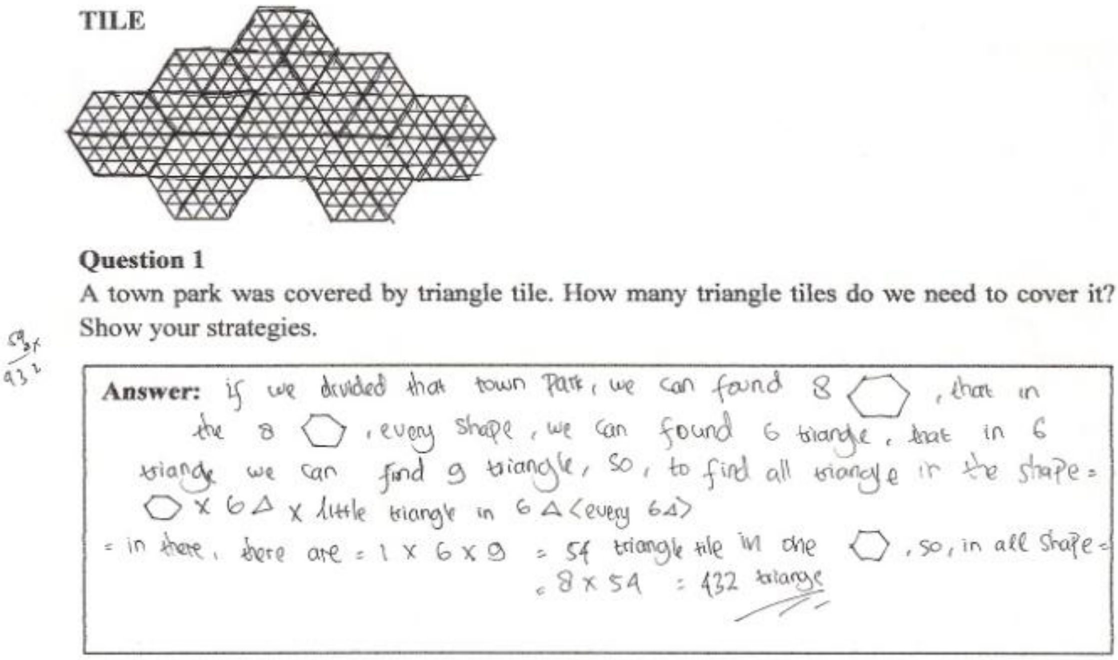
~~each people = 4 shakes hand.~~

~~if 5 people :~~

10 shake hands.

a b c d e

Figure4:*a Student (Nadira) attempt at solving the shake hand problem*


TILE

Question 1

A town park was covered by triangle tile. How many triangle tiles do we need to cover it? Show your strategies.

Answer: if we divided that town park, we can found 8 ⬡, that in the 8 ⬡, every shape, we can found 6 triangle, that in 6 triangle we can find 9 triangle, so, to find all triangle in the shape = ⬡ x 6△ x little triangle in 6△ (every 6△)
= in there, there are = 1 x 6 x 9 = 54 triangle tile in one ⬡, so, in all shape =
= 8 x 54 = 432 triangle

Figure5:*students' solution to the tile problem*

We could observe what student had done in shake hand problem, that the combinatory problem is based on situation from the everyday life. Although the picture at first view doesn't base on the real problem, the students know the form of question and they can imagine it. The solutions offered by Nadira are shown in figure 2 as example of students' works. She tried to do the problem without using the formula that probably more accustomed for the student. As can be seen in Nadira's solution, she correctly selected the probability as her strategy.

As can be seen in Nyimas' solution (figure 3), she selected multiplication as her strategy. Her idea was every hexagonal comprise six big triangles, and every big triangle comprise nine little triangles.

Result

Table 1: student's work result

Problem	Correct	Other responses	No working
Time 1	24	5	1
time 2	12	11	7
shake hand	5	10	15
plate	3	8	19
advertisement 1	20	4	6
advertisement 2	20	3	7
tile 1	12	13	5
tile 2	15	12	3
Total	111	66	63
Percentage	46%	28%	26%

Table above indicate that students achievement still in below of half.

CONCLUSION

PISA problems are related with everyday life. Most of the PISA problems related to description of the situation, and the students have to discover and solve the problem with their own strategies. Firstly, the students' of junior high school were unfamiliar with the problems because most of the problems given in the test just cover application cognitive levels, that is required to apply formulas or procedures to solve them. The problems don't have any connection with real life. After the students tried the test, they were becoming more comfort with the challenge of the problems. Hopefully, they will like mathematics. We are anxious that if the problems given in the tests only overarch the application of formulas and procedures the students don't like mathematics because they don't see why they need to learn it. In their everyday life they meet problems, where mathematics is present, and they don't know how to solve it, as they don't know how to transfer mathematics to practical problems.

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